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Relationships among a modifiable situational factor (unit cohesion), prior stressful life events, and posttraumatic stress disorder (PTSD) symptoms were assessed in 1,579 U.S. Army soldiers with no history of contemporary war zone deployment. It was predicted that unit cohesion would attenuate the dose-response relationship between past stressor exposures and PTSD symptoms at relatively moderate levels of exposure. Consistent with this hypothesis, regression analysis revealed that life experiences and unit cohesion strongly and independently predicted PTSD symptoms, and that unit cohesion attenuated the impact of life expectancy on PTSD. Some military personnel reported significant predeployment, stress-related symptoms. These symptoms may serve as vulnerabilities that could potentially be activated by subsequent war-zone deployment. Higher predeployment unit cohesion levels appear to ameliorate such sumptoms, potentially lessening future vulnerability.

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PTSD Symptoms, Life Events, and Unit Cohesion in U.S. Soldiers: Baseline Findings From the Neurocognition Deployment Health Study

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High rates of posttraumatic stress disorder (PTSD) have been documented among war-zone veterans (Duke & Vasterling, 2005), with some evidence suggesting that a dose-response relationship exists between war-zone stressor severity and PTSD symptom levels (see Dohrenwend et al., 2006, for a recent example). A variety of risk and resilience factors have been tentatively identified as modifying this relationship (see King, Vogt, & King, 2004; Maguen, Suvak, & Litz, 2006, for summaries). With large numbers of military personnel now deployed to combat situations, it is essential for health planning efforts to take into consideration the broader scope of factors potentially influencing mental health functioning in military personnel. In particular, because emotional functioning has rarely been assessed prospectively, prior to deployment, the impact of prewar-zone risk and resilience factors on postwar-zone mental health may not be fully appreciated. Understanding how individuals' predeployment personal histories and situational factors influence emotional functioning, including preexisting PTSD symptoms, prior to war-zone deployment may be critical to development of both predeployment preventive and postdeployment treatment interventions.

The primary purpose of this report is to describe risk and resilience factors potentially impacting troops prior to warzone deployment. Specifically, demographic, stressor exposure variables, and situational factors were measured in a large cohort of Army soldiers who had not yet been deployed to either Operation Iraqi Freedom (OIF) or Operation Enduring Freedom (OEF). As a situational factor, we focused on unit cohesion, a contextual military variable.

We chose to examine unit cohesion for several reasons. First, unit cohesion is potentially modifiable and therefore a candidate for integration into preventive mental health care policy. Second, unit cohesion is an intuitive construct historically recognized within military culture as having positive impact (Shay, 1994; von Clausewitz, 1832/1989). Finally, theoretical models of unit cohesion suggest that high levels of unit cohesion should constitute a major resilience source for military-related stressors, including those associated with combat (e.g., Bliese, 2006; Griffith & Vaitkus, 1999).

Empirical support for this assertion is generally positive, with numerous studies demonstrating that high levels of unit cohesion impart the expected resilience to cope with typical military-related stressors (see the meta-analysis by Oliver et al., 1999, for a review), and several studies demonstrating the resilience effect for combat-related stressors (e.g., McTeague, McNally, & Litz, 2004; Solomon & Mikulincer, 1990; Solomon, Mikulincer, & Hobfoll, 1986). In contrast, Fontana, Rosenheck, and Horvath (1997) found that whereas low to moderate unit cohesion was related to lower reported rates of PTSD symptoms, very high levels of unit cohesion were associated with higher than expected levels of PTSD symptoms among Vietnam combat veterans.

Consistent with the findings of Fontana et al. (1997), Suvak, Vogt, Suvarese, King, and King (2002) found a curvilinear interaction between various aspects of coping and life adjustment, with stress exposure levels moderating the interaction. More specifically, they demonstrated that the positive effect of problem-focused coping on quality of life increased as exposures mounted to moderate levels, but that the effect reversed (i.e., increases in problem-focused coping led to steadily decreasing levels of quality of life) when exposures surpassed moderate levels. Suvak et al. suggested that relatively high levels of problem-focused coping have increasing benefits as stressor levels mount to moderate levels due to the perception that the challenge presented by the mounting stressors is successfully being met. However, at the point at which stressors become overwhelming (e.g., during combat when a unit is incurring casualties that it cannot effectively curtail or is being overrun), the uncontrollability of the situation renders high levels of problem-focused coping counterproductive. This curvilinear interaction is hypothesized to be consistent with goodness of fit theories regarding effective coping (see Park, Folkman, & Bostrom, 2001, for recent support and review). By such theories, some coping mechanisms (e.g., problem-focused coping) are inappropriate in situations that have become uncontrollable.

Most formulations regarding the protective effects of unit cohesion on stress emphasize the formation of trust by an individual in both his or her compatriots and

supervisors, a dichotomy that Griffith and Vaitkus (1999) refer to as horizontal/peer versus vertical/leader bonding. This trust is considered by military leaders to be the emotional foundation that prevents the breakdown of problem-focused communication and problem solving under high levels of threat. As stress levels mount from low to medium levels, high levels of unit cohesion could help to engender confidence in members of a unit under attack, helping them to engage in problem-focused coping that proves to be effective. However, as stress levels become overwhelming and effective problem solving ineffectual, high levels of unit cohesion may be later seen as an illusion that has been betrayed, a formulation consistent with Fontana et al.'s (1997) suggestion that high levels of unit cohesion potentially lead to a consensual appraisal of a negative outcome as a catastrophe by surviving unit members.

Predictions were based on the assumption that, although military personnel will have experienced a range of prior life stressors, their immediate context (even if preparing for a deployment) would be characterized by the absence of overwhelming levels of stress. Specifically, we predicted that, whereas both stressful life events and unit cohesion would be independently associated with PTSD symptom levels prior to deployment, unit cohesion would also moderate the relationship between life events and PTSD. Given the restricted range of current stress levels in the nonwarzone environment for most participants, we did not expect this moderation effect to exhibit any curvilinear effects.

METHOD

Participants

Participants were Army soldiers assessed as part of the Neurocognition Deployment Health Study (NDHS; Vasterling et al., 2006; Vasterling, Proctor, Amoroso, Kane, Heeren, & White, 2006). Participants were sampled at the battalion-level military unit, with military units selected to reflect a mix of combat arms, combat support, and combat service support functions. Active duty units, comprising the majority of units, originated from Fort Hood, Texas, and Fort Lewis, Washington. National Guard units originated from Tennessee, Georgia, and Wisconsin. Assessment data reported here were gathered from April 2003 to July 2004. At the time, no unit had been deployed overseas as part of either OIF or OEF. Of 1,699 potential participants invited to participate, 1,595 agreed, reflecting a participation rate of 94%. Twelve participants were eliminated from data analyses for failure to complete major portions of the assessment, and four were removed due to missing information critical to PTSD diagnostic determination, leaving a final sample of 1,579. Of this group, 10% were women, 38% self-reported being a member of an ethnic minority, and 51% single. The sample averaged 26.0 years in age ($SD = 6.1$) and completed 12.6 years of formal education ($SD = 1.4$). Rank groupings included 71% categorized as junior enlisted (E1–E4), 25% as noncommissioned officers ($\geq$E5), and 4% as officers. Prevalent military occupations included infantry/gun crew (34%), electrical/mechanical repair (20%), communication/intelligence (20%), and service supply (10%). Eighty-six percent were regular active duty and 14% were activated reservists; 10% had served in a previous overseas operational deployment during their entire career, but only 2% had experienced an overseas operational deployment since September, 2001.

Measures

The PTSD Checklist (PCL), a widely-used 17-item self-report scale designed to measure distress associated with each PTSD symptom (King, Leskin, King, & Weathers, 1998; Weathers, Litz, Herman, Huska, & Keane, 1993), was used to derive *DSM-IV* (*Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition*; American Psychiatric Association, 1994) PTSD diagnoses. Initial validation efforts demonstrated good internal consistency for both the overall scale ($\alpha = .95$) and subscales measuring PTSD Criteria B, C, and D (αs ranging from .89 to .92). Cross-validation efforts comparing PCL diagnoses of PTSD with diagnoses derived from clinician-administered structured interviews have demonstrated acceptable accuracy as measured by kappas of .64 for a sample of Vietnam veterans (Weathers et al., 1993) and .83 in a sample

of motor vehicle accident and assault victims (Blanchard, Jones-Alexander, Buckley, & Forneris, 1996).

In this study, participants were asked to link their PCL responses to a stressful life event from their past. Subscales of a modified version of the Deployment Risk and Resilience Inventory (DRRI; King, King, Vogt, Knight, & Samper, 2006) documented stressful life events (17 items reflecting exposure to stressors such as physical and sexual assault, serious accident and physical injury, etc.) and military unit cohesion (12 items reflecting unit support and satisfaction with leadership such as "members of my unit understand me," "my unit is like family to me," "I am impressed by the quality of leadership in my unit," "the military appreciates my service"). Development of all DRRI scales reflect a rational test development process in which constructs under scrutiny were defined by expert consensus. Final test items, including life events and unit cohesion items, were selected on the basis of cross-validation studies conducted with two samples of military populations. Internal consistency scores for both scales were as expected (life events $\alpha = .75$; unit cohesion $\alpha = .94$), with the relatively moderate life events alpha reflecting predicted heterogeneity in life stressors (see King et al., 2006, for further discussion.)

Procedures

Participants completed demographic and self-report measures in small groups at military installations (Vasterling, Proctor, Amoroso, Kane, Gackstetter, Ryan, et al., 2006). Outliers greater than three standard deviations from each scale mean were recoded to the most extreme range value within three standard deviations of the mean. Missing values for PCL, unit cohesion, and life events scale items were extremely infrequent (missing data percentages were .2, .4, and .2 for each scale, respectively). For the PCL and unit cohesion subscales, missing data were imputed ideographically from all items present for a specific subscale. Missing life events items were omitted due to unreliability in estimating yes/no responses.

RESULTS

The mean PCL score for study participants was 29.41 ($SD = 12.77$). To meet minimal *DSM*-related criteria, a PTSD diagnosis was assigned to cases in which moderate or higher responses (i.e., ≥ 3 on a 5-point Likert scale item) were provided for at least one intrusion symptom (Criterion B), three avoidance/numbing symptoms (Criterion C), and two hyperarousal symptoms (Criterion D); following Hoge et al. (2004), a minimum PCL score of 50 was required in addition to the *DSM*-prescribed pattern. Using this decision rule, the percentage of study participants meeting full PCL-derived PTSD criteria was 10%.

Factors Predicting Posttraumatic Stress Disorder

A hierarchical regression equation adjusted for demographic variables examined the associations of stressor exposure and unit cohesion with PTSD symptoms. The dependent variable was total PCL score, with higher values indicating greater levels of PTSD symptoms. Independent variables were centered and entered in two steps. Step 1 contained the independent variable of interest (life events and unit cohesion scores). In addition, to examine the associations of life events and unit cohesion independently of potential confounding variables, Step 1 contained military variables and demographic variables commonly identified as covarying with PTSD: gender, age, rank (junior enlisted vs. noncommissioned officer/officer), marital status (married vs. not married), education (in years), self-reported ethnicity (White vs. minority), duty status (active duty vs. reservist), and prior career deployment status (yes vs. no). Step 2 contained a product term for life events and unit cohesion (Life Events × Unit Cohesion) to examine possible linear moderation effects. Following statistical recommendations of Aiken and West (1991) and Suvak et al. (2002), two additional terms were included at Step 3 to test for potential curvilinear or quadratic effects. The first term reflects the hypothesized curvilinear relationship of the life event variable with the dependent variable; the term is constructed by squaring the life events scale (life events^2). The second term is the quadratic term, which

specifically estimates potential curvilinear interaction effects; this term is derived by taking the product of the squared life events scale and the unit cohesion scale (life events^2 × unit cohesion).

Analysis of variance (ANOVA) tests were significant for the initial regression model at Step 1 and the model after Step 2 (see Table 1). At Step 1, younger age, minority status, and higher levels of life stress were associated with greater PCL scores, whereas higher unit cohesion was associated with lower PCL scores. Secondary analyses indicate that life events and unit cohesion effects, even when controlling for covariance with demographic factors, predominated at Step 1, together accounting for 22% of the total variance in PCL scores. The linear moderator effect at Step 2 was significant, though small ($\Delta R^2 = .004$); such small moderator effect sizes are to be expected, given constraints on main effects typically found in social science experiments (Cohen, Cohen, West, & Aiken, 2003). The overall fit of the model did not significantly improve with the inclusion of Step 3 variables, $F < 1$; $\Delta R^2 = .001$; t tests were not significant for either the curvilinear aspect of life events, $\beta = .03$, *ns*, or importantly, for the curvilinear interaction term, $\beta = .01$, *ns*. These null results suggest that the moderator effect is linear in nature and that terms reflecting a curvilinear effect should not be included in the final model. All variables significant at Step 1 remained significant in the final model.

The significant moderator effect can be interpreted in two complimentary ways. Simple slope tests of the moderator (Aiken & West, 1991) indicate (a) that associations between life events and PCL scores weakened as unit cohesion increased, and (b) that associations between unit cohesion and PCL scores strengthened (e.g., the magnitude of reductions in PCL scores associated with increasing levels of unit cohesion) as the incidence of stressful life events increased. The latter presentation is consistent with models that predict increasing effectiveness for unit cohesion in mitigating PTSD symptoms when levels of stressors are at low to medium levels. Step 2 effects therefore suggest that unit cohesion is associated with PTSD symptoms both directly (increasing unit cohesion levels are independently associated with decreasing PCL scores) and indirectly (increasing unit cohesion levels are associated with decreased influence of life events on PCL scores).

Table 1. Hierarchical Regression Analysis for Centered Demographic, Life Events, Unit Cohesion, and Moderator Variables Predicting Posttraumatic Stress Disorder ($N = 1,579$)

Variable	*B*	*SE B*	β
Step 1			
Gender	1.35	0.95	.03
Age	−0.16	0.06	−.08**
Rank	−0.96	0.77	−.03
Marital status	−0.39	0.60	−.02
Education	−0.28	0.21	−.03
Ethnicity	−2.40	0.60	−.09***
Prior deployment	−0.79	1.03	−.02
Reserve status	−0.50	0.88	−.01
Life events score	1.20	0.08	.32***
Unit cohesion score	−0.37	0.03	−.32***
Step 2			
Gender	1.30	0.95	.03
Age	−0.16	0.06	−.08*
Rank	−1.03	0.77	−.04
Marital status	−0.40	0.60	−.02
Education	−0.26	0.21	−.03
Ethnicity	−2.42	0.60	−.09***
Prior deployment	−0.74	1.03	−.02
Reserve status	−0.53	0.88	−.01
Life events score	1.18	0.08	.32***
Unit cohesion score	−0.37	0.03	−.32***
Life Events × Unit Cohesion term	−0.02	0.01	−.06**

Note. For Step 1, $R^2 = .26$, $F(10, 1568) = 55.60$, $p < .001$; for Step 2, $\Delta R^2 = .004$, $\Delta F(1, 1567) = 8.55$, $p < .01$; final $R^2 = .27$, $F(11, 1567) = 51.57$, $p < .001$.
*$p < .05$. **$p < .01$. ***$p < .001$.

Unit Effects on Posttraumatic Stress Disorder

A potential contributor to the above-described linear interaction is the influence of unit assignment. In other words, units as a whole may systematically vary in their levels of cohesion, making the cohesion-PTSD relationship for individual Army personnel contingent, in part, on unit assignment for each soldier. This possibility is suggested by multiple studies indicating a significant relationship

between individually reported unit cohesion and unit assignment (see Griffith, 2002, for a review). A major grouping variable such as unit membership, when unacknowledged, can also result in significant increases in both Type 1 and Type 2 error rates for multiple regression results (Bliese & Hanges, 2004), even with the use of large samples (Barcikowski, 1981).

Following methodological suggestions by Hox (2002), an "intercepts-only" multilevel model was therefore constructed. Such a model is conceptually similar to a one-way ANOVA, with one critical difference being that the fixed ANOVA grouping variable is instead treated as a random factor in a regression analysis. For the purposes of this analysis, unit assignment at the battalion level was entered as a level 2 (i.e., grouping) variable in a multilevel model, and a covariance parameter estimate was calculated. This parameter estimated variance in PCL scores accounted for by unit assignment and was examined by means of a z test to determine if mean PCL scores for units varied more than would be expected by chance. Such an analysis provided a covariance parameter estimate of 1.40 (residual = 161.40), which was not statistically significant, $z = 1.15$, $p = .13$, one-tailed test. Calculation of the intraclass correlation (an estimate of effect size in multilevel model for the relationship between a level 2 predictor and a dependent variable) for unit assignment and PCL scores obtained a value of $\rho < .01$, indicating that less than 1% of variance in PCL scores in this sample is associated with unit assignment. Taken together, these results suggest that unit assignment, measured at the battalion level, was not a significant predictor of PTSD symptom levels in this sample.

DISCUSSION

This sample of military personnel reported moderate levels of PTSD symptoms, with a screening estimate of current PTSD of 10%. Thus, even using a stringent criterion for PTSD diagnosis, PTSD rates exceeded expectations for a noncombat, predominantly male, American group (i.e., a predicted weighted lifetime rate of 5.5%, according to documented male/female PTSD rates in the United States; Kessler, Sonnega, Bromet, Hughes, & Nelson, 1995). Although differences in prevalence rates may vary by chance among samples, report of PTSD symptoms was linked to specific life experiences, suggesting that the increased prevalence is not attributable to artifact (e.g., participants reporting generalized distress that is not directly associated with a particular life event). This finding is consistent with epidemiological studies that have demonstrated high-exposure rates to premilitary stressors among military personnel (Hourani, Yuan, & Bray, 2003; Merrill et al., 1998; Stretch, Knudson, & Durand, 1998). Given research indicating that prior emotional disturbance increases stress vulnerability (e.g., King, King, Foy, & Gudanowski, 1996), this elevated rate of noncombat PTSD suggests that a subset of these service men and women may be at heightened risk for exacerbation of already existing PTSD during or after war-zone service.

Findings further suggest that, in addition to demographic variables, life experiences and perceived unit cohesion contribute independently to prediction of PTSD symptoms. Among demographic variables included in the regression, only age and ethnicity significantly predicted PTSD, with younger age and ethnic minority status contributing to heightened PTSD symptoms, when controlling for nondemographic variables. Prior stressful life events strongly predicted PTSD symptoms, supporting a dose-response relationship (Ozer, Best, Lipsey, & Weiss, 2003). Extending studies indicating that unit cohesion factors impact combat-related PTSD (Bowman & Yehuda, 2004); unit support and satisfaction with leadership significantly predicted noncombat-related PTSD symptoms in a military sample, even when controlling for demographic variables and life stressors. In addition, findings suggest that the association of stressful life events with PTSD symptoms decreases as unit cohesion increases, or, put another way, that the association of unit cohesion with PTSD symptoms increases as stressful life events increase. Consistent with study hypotheses, a curvilinear moderator effect was not found, suggesting that the levels of stressors typically associated with predeployment Army duty do not reach levels sufficiently severe as to overwhelm the positive coping function of high levels of unit cohesion. Thus, by both direct and indirect pathways, higher levels of unit cohesion

appear to be particularly beneficial among individuals exposed to significant stress prior to their military careers. Such results have implications for both pre- and postdeployment healthcare, suggesting the potential importance of developing interventions that target perceived leadership and social support within military units.

Study limitations include derivation of PTSD diagnoses by self-report measure, the subjective nature of some life event items, and retrospective measurement of predeployment stressors. However, these limitations are balanced against a large sample of Army personnel who reflect a full range of military duties and occupational specialties and were examined prior to overseas deployment. Predeployment measurement of unit cohesion is especially helpful in that, it can serve in subsequent analyses as a relatively objective indicator of unit satisfaction prior to exposure to the stressors of combat. Reliance on postdeployment measurement of stressor levels and unit cohesion, without premilitary measures to serve as a baseline, cannot exclude the possibility than any observed curvilinear relationships are artifactual in nature. Simply put, it could be that individuals experiencing high levels of overwhelming symptoms engage in a biased reporting referred to by Brown (1974) as an "effort after meaning." Thus, this study provides key predeployment information highly relevant to disentangling these causal questions regarding the growing ground forces currently deployed overseas and suggests that substantial stress-related emotional symptoms may exist in military personnel prior to overseas deployment. Given the poor mental health outcomes associated with contemporary war-zone deployments (Hoge, Auchterloine, & Milliken, 2006), such preexisting symptoms may serve as vulnerabilities that are subsequently activated by war-zone deployment (Friedman, 2004). Yet, at least one potentially modifiable factor (unit cohesion) is associated with expression of stress-related symptoms, and interventions designed to increase unit cohesion may help ameliorate such vulnerabilities. Ongoing longitudinal efforts with this cohort promise to provide data relevant to the interplay between predeployment, war-zone, and postdeployment factors and their impact on mental health outcomes.

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